

Attorney's Docket 071469-0307692
Client Reference: RAJ-024



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT APPLICATION of:
HONGYU YUE ET AL.

Confirmation Number: 1294

Application No.: 10/817,417

Group Art Unit: 1765

Filed: March 30, 2004

Examiner: Kin C. Chen

For: METHOD AND SYSTEM FOR PERFORMING A CHEMICAL OXIDE REMOVAL
PROCESS

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT/RESPONSE TRANSMITTAL

Transmitted herewith is an amendment/response for this application.

FEES

The fee for the Appeal Brief Under 37 C.F.R. §41.37 has been calculated as shown below:

	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NO. PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDIT. FEE
TOTAL	9	-	20	= 0	X \$ = \$
INDEP.	3	-	3	= 0	X \$ = \$
FIRST PRESENTATION OF MULTIPLE DEP. CLAIM				+	\$ = \$ 0.00
TOTAL ADDITIONAL CLAIM FEE					\$
GRAND TOTAL					\$ 500.00




FEE PAYMENT

Authorization is hereby made to charge the amount of \$500.00 to Deposit Account No. 033975. Charge any additional fees required by this paper or credit any overpayment in the manner authorized above. A duplicate of this paper is attached.

Date: October 19, 2006

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AS/

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE HONORABLE
BOARD OF PATENT APPEALS AND INTERFERENCES**

IN RE PATENT APPLICATION OF: **YUE *et al.***
SERIAL No.: **10/817,417**
ATTORNEY DOCKET No: **071469-0307692**
FILING DATE: **March 30, 2004**
ART UNIT : **1294**
EXAMINER **CHEN, KIN C.**
FOR: **TOKYO ELECTRON LIMITED**

- APPEAL BRIEF UNDER 37 C.F.R. §41.37 -

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Mail Stop APPEAL BRIEF - PATENTS

Commissioner for Patents
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Dear Sir:

Further to the Notice of Appeal, filed on August 15, 2006, the Notice of Panel Decision from Pre-Appeal Brief Review dated September 20, 2006, and the Final Office Action of June 20, 2006, Appellants respectfully submit this Appeal Brief pursuant to 37 C.F.R. §41.37, the date for submitting being set by the Notice of Panel decision to October 20, 2006.

The Director is authorized to charge the \$500.00 fee for filing an Appeal Brief pursuant to 37 C.F.R. §41.20(b)(2). The Director is further authorized to charge any additional fees that may be due, or credit any overpayment of same to Deposit Account No. **03-3975** (Ref. No. 071469-0307692).

- REQUIREMENTS OF 37 C.F.R. § 41.37 -

I. 37 C.F.R. § 41.37(c)(1)(i) – REAL PARTY IN INTEREST

The real party in interest for this Appeal and the present application is TOKYO ELECTRON LIMITED by way of an Assignment recorded in the U.S. Patent Trademark Office at Reel/Frame: 015553/0095.

II. 37 C.F.R. § 41.37(c)(1)(ii) - RELATED APPEALS AND INTERFERENCES

There are presently no appeals or interferences known to the Appellants, the Appellants' representatives or the Assignee, which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. 37 C.F.R. § 41.37(c)(1)(iii) - STATUS OF CLAIMS

Pending: Claims 1-6 and 8-10 are pending.

Withdrawn: Claims 10-11 have been withdrawn.

Rejected: Claims 1-6 and 8-9 stand rejected.

Cancelled: Claims 7 and 11 have been cancelled.

Allowed: No claims have been allowed.

On Appeal: Claims 1-6 and 8-9 are being appealed. Of the claims on Appeal, claims 1 and 9 are the sole independent claim. The claims on Appeal are set forth in the attached Appendix.

IV. 37 C.F.R. § 41.37(c)(1)(iv) - STATUS OF AMENDMENTS

No amendments have been filed subsequent to the Final Office Action of June 20, 2006.

V. 37 C.F.R. § 41.37(c)(1)(v) - SUMMARY OF CLAIMED SUBJECT MATTER

Independent claims 1 and 9, as described below, include references and citations to the specification, drawings, and reference numerals. Such description is intended to facilitate an understanding of the claims by the Board Members and is not intended as a comprehensive claim construction, such as used in the context of an argument of invalidity or infringement. Any reference to more than one reference number or character for any particular claimed element or limitation is illustrative only and is not to be construed as an admission that the claims are limited to any, or all, of the particularly disclosed embodiments.

The claimed subject matter relates to a method of achieving a target trim amount of a substrate feature in a chemical oxide removal process. (*See*, Specification: par. [0090]). The method includes acquiring trim amount data as a function of time (*i.e.*, time in which a substrate is exposed to the first and second process gases) for a process recipe. (*See*, Specification: par. [0091]; FIG. 18).

The method further requires determining a relationship between a value related to the trim amount data relative to time by applying a curve fit function to the acquired trim amount data. In the embodiments of interest, the curve fit function is provided by the following log relationship:

$$x = L \ln(t) + L \ln(C/L),$$

where x : represents the trim amount data;
 t : represents time; and
 L, C : represent constants for the process recipe.

(*See*, Specification: par. [0085]-[0086], [0091]; FIG. 18).

The method then requires the use of the target trim amount and the determined relationship to determine a target trim time for achieving the target trim amount. (*See*, Specification: par. [0092]; FIG. 18).

Finally, the method requires chemically treating the substrate feature by exposing the substrate using the process recipe for the target trim time and substantially removing the target trim amount from the feature. (*See*, Specification: par. [0093]- [0094]; FIG. 18).

To this end, independent claim 1, as it currently stands, sets forth the following:

1. A method for achieving a target trim amount of a feature on a substrate in a chemical oxide removal process (FIG. 18: item 900; par. [0090]) comprising:

acquiring trim amount data as a function of time for a process recipe (FIG. 18: item 910; par. [0090]);

determining a relationship between a value related to said trim amount data and time (FIG. 18: item 920; par. [0085]-[0086],[0091]);

using said target trim amount and said relationship to determine a target trim time for achieving said target trim amount (FIG. 18: item 930; par. [0092]);

chemically treating said feature on said substrate by exposing said substrate using said process recipe for said target trim time (FIG. 18: item 940; par. [0093]); and

substantially removing said target trim amount from said feature, wherein said determining includes fitting said trim amount data as said function of time with a log relationship of the form $x = L \ln(t) + L \ln(C/L)$, wherein x represents trim amount data, t represents time, and L and C are constants for said process recipe (FIG. 18: item 950; par. [0085]-[0086],[0091], [0094]).

Independent claim 9, as it currently stands, sets forth the following:

9. A method for achieving a target trim amount of a feature on a substrate in a chemical oxide removal process (FIG. 18: item 900; par. [0090]) comprising:

acquiring trim amount data as a function of time for a process recipe, wherein said process recipe comprises a flow rate of HF, a flow rate of NH_3 , and a pressure (FIG. 18: item 910; par. [0090]);

fitting said trim amount data as said function of time with a log relationship of the form $x = L \ln(t) + L \ln(C/L)$, wherein x represents

trim amount data, t represents time, and L and C are constants for said process recipe (FIG. 18: item 920; par. [0085]-[0086],[0091]);

using said target trim amount and said exponential relationship to determine a target trim time for achieving said target trim amount (FIG. 18: item 930; par. [0092]);

chemically treating said feature on said substrate by exposing said substrate using said process recipe for said target trim time (FIG. 18: item 940; par. [0093]); and

substantially removing said target trim amount from said feature (FIG. 18: item 950; par. [0094]).

VI. 37 C.F.R. § 41.37(c)(1)(vi) - GROUNDS OF REJECTION TO BE REVIEWED

The grounds of rejection submitted for review are those identified in the Final Office Action, as follows:

(a) the rejection of claims 1-6 and 8-9: under 35 U.S.C. § 103(a), as allegedly being unpatentable over Tomoyasu '583 (U.S. Patent Application Publication 2004/0185583) as evidenced by Wadsworth (*Handbook of Statistical Methods for Engineers and Scientists*, 1998); and

(b) the rejections of claims 1, 4-6, and 8-9: under 35 U.S.C. § 103(a), as allegedly being unpatentable over Natzle '047 (U.S. Patent Application Publication 2004/0097047) as evidenced by Wadsworth.

VII. 37 C.F.R. § 41.37(c)(1)(vi) - ARGUMENT

To the point, the prior art rejections must fail because none of the asserted references, whether taken alone or in combination, teach or suggest the entire claimed combination of elements, including the feature of determining a relationship between a value related to the trim amount data and time, wherein the determination includes fitting the trim amount data as the function of time with a log relationship of the form $x = L \ln(t) + L \ln(C/L)$.

In particular, while the use of statistical models and curve-fitting relationships may be well-known, there is nothing in the asserted references that remotely teach or suggest the specific fitting relationship recited by the claims - much less, applying such a relationship to trim amount data.

A. Claims 1-6 & 8-9 Are Not Obvious Over Tomoyasu '583 & Wadsworth

The Examiner asserted that Tomoyasu '583 and Wadsworth render claims 1-6 and 8-9 unpatentable as the combination of these references allegedly teach each and every claim element. Appellants respectfully submit that these rejections are woefully unsupported.

As a preliminary matter, Appellants point out that the first criteria in establishing a *prima facie* case of obviousness requires some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. As a corollary to this requirement, the Federal Circuit has specifically held that the mere fact that *the prior art could be modified* as proposed by the Examiner *is not sufficient* to establish a *prima facie* case of obviousness. (See, *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1783 (Fed. Cir. 1992) (*emphasis added*). Rather, the Examiner *must explain why the prior art would have suggested* to one of ordinary skill in the art *the desirability of the modification*. (See *Fritch*, 972 F.2d at 1266, 23 USPQ2d at 1783-84) (*emphasis added*).

Appellants further point out that, much like the well-settled patent principles regarding optimization of ranges, prior art teachings that merely provide numerical values that fall within a claimed parameter relationship do *not* defeat patentability. (MPEP §2144.05.II.A). Nor should it matter, in this case, for the sake of patentability, that general statistical models and curve-fitting relationships are well-known. What does matter is that a parameter relationship *must first be recognized in the prior art as a result-effective variable*, *i.e.*, a variable which achieves a recognized result, before the determination of the

optimum or workable ranges of the variable might be characterized as routine experimentation. (MPEP §2144.05.II.B; *see also*, *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977))(*emphasis added*).

With this said, Appellants submit that Tomoyasu '583 teaches a processing subsystem **150** that can be a chemical oxide removal (COR) system for trimming an oxide hard mask. The processing subsystem **150** may comprise a COR module **154** for chemically treating exposed surface layers, such as oxide surface layers, on a substrate, in which absorption of the process chemistry on the exposed surfaces affects the chemical alteration of the surface layers. (*See*, Tomoyasu '583: par. [0059]).

Tomoyasu '583 further discloses that a predicted state for the wafer may be computed based on the input state, the process characteristics, and a process model. For example, a trim rate model can be used along with a processing time to compute a predicted trim amount. Alternately, an etch rate model can be used along with a processing time to compute an etch depth, and a deposition rate model can be used along with a processing time to compute a deposition thickness. Other models identified by Tomoyasu '583 include SPC charts, PLS models, PCA models, FDC models, and MVA models. (*See*, Tomoyasu '583: par. [0074]).

Despite its comprehensive disclosures, there is absolutely nothing in Tomoyasu '583 that teaches or suggests fitting the trim amount data as a function of time with a log relationship of the form $x = L \ln(t) + L \ln(C/L)$, as required by claims 1 and 9.

The Examiner, however, summarily asserted that, because Tomoyasu '583 identifies various statistical models, it would have been obvious to apply commonly used engineering calculations and curve fitting techniques and relied on Wadsworth as providing evidence of such logarithmic-based relationships. (*See*, Office Action: page 4).

In response, Appellants first point out that, as an academic reference, Wadsworth is directed to developing the theory behind statistical modeling and merely identifies generic, logarithmic-based statistical relationships. In so doing, Wadsworth does not, in any way whatsoever, teach the specific fitting relationship required by claims 1 and 9.

Moreover, to summarily assert that the specific fitting relationship, as claimed, is rendered obvious by the mention of Tomoyasu '583 that a trim rate model could be used or Wadsworth's generic logarithmic-based relationships, flies in the face of the well-settled principles noted above and can only be rooted in hindsight.

There is simply no suggestion in Tomoyasu '583 and Wadsworth of the claimed fitting relationship and the notion that Tomoyasu '583 *could* be modified to achieve such a feature, is insufficient to establish obviousness, as noted above. And, even if, *in arguendo*, the claimed fitting relationship could somehow be derived from the generic relationships identified by Wadsworth, the fact is that the claimed relationship is simply *not recognized* as a result-effective variable in the prior art. As discussed above, such lack of recognition manifests the patentability of the claimed relationship.

For at least these reasons, Appellants submit that independent claims 1 and 9 are not rendered obvious by Tomoyasu '583 and Wadsworth and are clearly patentable. Moreover, because claims 2-6 and 8 depend, either directly or indirectly from claim 1, claims 2-6 and 8 are also patentable at least by virtue of dependency as well as for their additional recitations.

B. Claims 1, 4-6, & 8-9 Are Not Obvious Over Natzle '047 & Wadsworth

The Examiner asserted that Natzle '047 and Wadsworth render claims 1, 4-6 and 8-9 unpatentable as the combination of these references allegedly teach each and every claim element. Appellants strenuously disagree.

For these rejections, Appellants substantially rely on the reasons presented above regarding Tomoyasu '583 and Wadsworth to establish the patentability of 1, 4-6 and 8-9. In short, Natzle '047 discloses the use of a pre-cleaning step by introducing a CMOS device **10** into a Chemical Oxide Removal (COR) chamber **44**, which employs gas phase reactants (*e.g.*, HF and NH₃) to perform a self-limiting etch that is adjustable by controlling the parameters in the COR chamber **44**. (*See*, Natzle '047: par. [0037]). Natzle '047 further discloses that the completion of the reaction and the amount of the gate dielectric layer **14** and the reoxidized silicon oxide layer **18** that are removed is a function of the substrate temperature, composition and residence time of the adsorbed reactant film **20**. Factors influencing the amount removed per unit time include the vapor pressure of the reactant at the temperature of the substrate **12**, the amount of reactant or the rate of reactant admitted to the COR chamber **44**, the pumping speed of pump **60**, and the reaction rate between the adsorbed reactant film **20** and the reoxidized silicon oxide layer **18** to be etched. (*See*, Natzle '047: par. [0042]).

With this said, like Tomoyasu '583, Natzle '047 is completely devoid of teaching or suggesting fitting the trim amount data as a function of time with a log relationship of the form $x = L \ln(t) + L \ln(C/L)$, as required by claims 1 and 9. And, as discussed above, Wadsworth also fails to teach or suggest the specific fitting relationship required by claims 1 and 9.

Moreover, there is simply no suggestion in either Natzle '047 or Wadsworth to modify the teachings to achieve the claimed fitting relationship. Nor is the claimed relationship recognized as a result-effective variable in the prior art.

Thus, for at least these reasons, Appellants submit that independent claims 1 and 9 are not rendered obvious by Natzle '047 and Wadsworth and are clearly patentable. Moreover, because claims 2-6 and 8 depend, either directly or indirectly from claim 1,

claims 2-6 and 8 are also patentable at least by virtue of dependency as well as for their additional recitations.

VIII. 37 C.F.R. §41.37(c)(1)(viii) - CLAIMS APPENDIX

APPENDIX A: The pending claims (claims 1-6 and 8-10) are attached.

IX. 37 C.F.R. §41.37(c)(1)(ix) - EVIDENCE APPENDIX

APPENDIX B: (NONE)

X. 37 C.F.R. §41.37(c)(1)(x) - RELATED PROCEEDINGS INDEX

APPENDIX C: (NONE)

XI. CONCLUSION

For at least the foregoing reasons, it is respectfully submitted that claims 1-6 and 8-9 not rendered obvious, under 35 U.S.C. §103(a), by the asserted references. Appellants, therefore, respectfully request this Honorable Board to reverse the rejection of these claims and direct that the claims be passed to issue.

Date: **October 19, 2006**

Respectfully submitted,

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- 37 C.F.R. § 41.37(c)(viii): APPENDIX A -

1. A method for achieving a target trim amount of a feature on a substrate in a chemical oxide removal process comprising:

acquiring trim amount data as a function of time for a process recipe;

determining a relationship between a value related to said trim amount data and time;

using said target trim amount and said relationship to determine a target trim time for achieving said target trim amount;

chemically treating said feature on said substrate by exposing said substrate using said process recipe for said target trim time; and

substantially removing said target trim amount from said feature, wherein said determining includes fitting said trim amount data as said function of time with a log relationship of the form $x = L \ln(t) + L \ln(C/L)$, wherein x represents trim amount data, t represents time, and L and C are constants for said process recipe.

2. The method of claim 1, wherein said substantially removing said trim amount from said feature comprises thermally treating said substrate by elevating the temperature of said substrate following said chemical treating.

3. The method of claim 1, wherein said substantially removing said trim amount from said feature comprises rinsing said substrate in a water solution following said chemical treating.

4. The method of claim 1, wherein said acquiring trim amount data includes acquiring said trim amount data as said function of time for one flow rate of HF, one flow rate of NH_3 , one pressure, and one substrate temperature.

5. The method of claim 4, wherein said acquiring trim amount data further includes acquiring said trim amount data as said function of time for one flow rate of argon.

6. The method of claim 1, wherein said chemically treating said feature includes chemically treating a silicon oxide feature.

7. (Cancelled).

8. The method of claim 1, wherein said determining includes fitting a first derivative of said trim amount data as said function of time with an exponential relationship of the form $dx/dt = C e^{(-x/L)}$, wherein dx/dt represents the first derivative of trim amount data, x represents trim amount data, t represents time, and L and C are constants for said process recipe.

9. A method for achieving a target trim amount of a feature on a substrate in a chemical oxide removal process comprising:

acquiring trim amount data as a function of time for a process recipe, wherein said process recipe comprises a flow rate of HF, a flow rate of NH_3 , and a pressure;

fitting said trim amount data as said function of time with a log relationship of the form $x = L \ln(t) + L \ln(C/L)$, wherein x represents trim amount data, t represents time, and L and C are constants for said process recipe;

using said target trim amount and said exponential relationship to determine a target trim time for achieving said target trim amount;

chemically treating said feature on said substrate by exposing said substrate using said process recipe for said target trim time; and

substantially removing said target trim amount from said feature.

10. (*Withdrawn*): A system for achieving a target trim amount on a substrate in a chemical oxide removal process comprising:

a chemical treatment system for altering exposed surface layers on said substrate by exposing said substrate to a flow rate of a first process gas, and a flow rate of a second process gas, for a target exposure time;

a thermal treatment system for thermally treating said chemically altered surface layers on said substrate; and

a controller coupled to said chemical treatment system and configured to use a relationship between trim amount and exposure time in order to determine said target exposure time for achieving said target trim amount for said flow rate of said first process gas and said flow rate of said second process gas, wherein said relationship includes a log relationship of the form $x = L \ln(t) + L \ln(C/L)$, wherein x represents trim amount data, t represents time, and L and C are constants for said process recipe.

11. (*Cancelled*).

- APPENDIX B -

(NONE)

- APPENDIX C -

(NONE)